

Application No. 09/741,639

Atty Docket: 3COM 3423-1

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Previously presented) A method of determining data flow for a channel having a plurality of subchannels in a multi-carrier system, comprising:

determining data flow for the channel in terms of an input intensity  $\lambda_{in}$ , and a probability of having a frame having no or a correctable number of errors  $p$ ; and  
adjusting channel performance in accordance with the data flow.

2. (Previously presented) The method of claim 1 wherein said data flow is determined in accordance with the following relationships:

$$\lambda_{nuc} = \lambda_{in} \frac{[1 - (1 - p)^k] (1 - p)}{p}$$

$$\lambda_n = \lambda_{in} \frac{1 - (1 - p)^k}{p},$$

$$\lambda_{pout} = \lambda_{in} [1 - (1 - p)^k],$$

$$\lambda_r = \lambda_{in} \frac{(1 - p) [1 - (1 - p)^{k-1}]}{p}, \text{ and}$$

$$\lambda_{nout} = \lambda_{in} (1 - p)^k,$$

$\lambda_{nuc}$  represents a negative acknowledgement intensity,  $k$  represents a maximum number of transmissions,  $\lambda_n$  represents a transmitter intensity,  $\lambda_{pout}$  represents an intensity of good and correctable frames;  $\lambda_r$  represents a retransmission intensity;  $\lambda_{nout}$  represents an intensity of erroneous frames that are non-correctable after a maximum number of transmissions.

3. (Original) The method of claim 2 wherein the data flow is determined by applying said relationships to data flow in a downstream direction, and applying said relationships to data flow in an upstream direction.

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4. (Previously presented) A method of determining data flow for a channel having a plurality of subchannels in a multi-carrier system, comprising:

determining an upstream data flow;  
determining a downstream data flow; and  
superimposing the upstream data flow and the downstream data flow to  
determine a channel data flow.

5. (Original) The method of claim 4 wherein the channel uses forward error correction.

6-8. (Cancelled)

9. (Previously presented) The method of claim 8 wherein the representation is generated in accordance with the following relationships:

$$\frac{M_d}{K_d} \left[ \frac{1}{m_d} + \frac{1-p_d}{p_d} \right] \left[ 1 - (1-p_d)^{k_d} \right] \Lambda_d + \frac{N_u}{K_u} \frac{1 - (1-p_u)^{k_u}}{p_u} \Lambda_u \leq V_u, \text{ and}$$

$$\frac{N_d}{K_d} \frac{1 - (1-p_d)^{k_d}}{p_d} \Lambda_d + \frac{M_u}{K_u} \left[ \frac{1}{m_u} + \frac{1-p_u}{p_u} \right] \left[ 1 - (1-p_u)^{k_u} \right] \Lambda_u \leq V_d,$$

wherein  $M_d$  represents a length of an acknowledgment frame in a downstream direction,  $K_d$  represents the length of an information field in the downstream direction,  $m_d$  represents a number of information frames between positive acknowledgment frames in the downstream direction,  $p_d$  represents a probability of an information frame being accepted in the downstream direction,  $k_d$  represents a maximum number of transmissions in the downstream direction,  $\Lambda_d$  represents a number of information bits per unit time in the downstream direction,  $N_d$  represents a total frame length in the downstream direction,  $M_u$  represents a length of an acknowledgment frame in an upstream direction,  $N_u$  represents a total frame length in the upstream direction,  $K_u$  represents the length of an information field in the upstream direction,  $m_u$  represents a number of information frames between positive acknowledgment frames in the upstream direction,  $p_u$  represents a probability of an information frame being accepted

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in the upstream direction,  $k_u$  represents a maximum number of transmissions in the upstream direction,  $\Lambda_u$  represents a number of information bits per unit time in the upstream direction,  $V_u$  represents a data rate in the upstream direction, and  $V_d$  represents a data rate in the downstream direction.

10. (Original) A method of determining throughput in a multicarrier transmission system, comprising:

determining the throughput of a channel in an upstream and downstream direction in accordance with the following relationships:

$$H_u = \max \Lambda_u = \min \left\{ \begin{array}{l} V_u / \left[ \frac{N_d}{K_d} \frac{1 - (1 - p_d)^{k_d}}{p_d} + \frac{M_u}{K_u} \frac{V_u}{V_d} \left( \frac{1}{m_u} + \frac{1 - p_u}{p_u} \right) (1 - (1 - p_u)^{k_u}) \right], \\ V_u / \left[ \frac{M_d}{K_d} \frac{V_d}{V_u} \left( \frac{1}{m_d} + \frac{1 - p_d}{p_d} \right) (1 - (1 - p_d)^{k_d}) + \frac{N_u}{K_u} \frac{1 - (1 - p_u)^{k_u}}{p_u} \right] \end{array} \right\}, \text{ and}$$

$$H_d = \max \Lambda_d = \min \left\{ \begin{array}{l} V_d / \left[ \frac{N_d}{K_d} \frac{1 - (1 - p_d)^{k_d}}{p_d} + \frac{M_u}{K_u} \frac{V_u}{V_d} \left( \frac{1}{m_u} + \frac{1 - p_u}{p_u} \right) (1 - (1 - p_u)^{k_u}) \right], \\ V_d / \left[ \frac{M_d}{K_d} \frac{V_d}{V_u} \left( \frac{1}{m_d} + \frac{1 - p_d}{p_d} \right) (1 - (1 - p_d)^{k_d}) + \frac{N_u}{K_u} \frac{1 - (1 - p_u)^{k_u}}{p_u} \right] \end{array} \right\},$$

wherein  $M_d$  represents a length of an acknowledgment frame in a downstream direction,  $K_d$  represents the length of an information field in the downstream direction,  $m_d$  represents a number of information frames between positive acknowledgment frames in the downstream direction,  $p_d$  represents a probability of an information frame being accepted in the downstream direction,  $k_d$  represents a maximum number of transmissions in the downstream direction,  $\Lambda_d$  represents a number of information bits per unit time in the downstream direction,  $N_d$  represents a total frame length in the downstream direction,  $M_u$  represents a length of an acknowledgment frame in an upstream direction,  $N_u$  represents a total frame length in the upstream direction,  $K_u$  represents the length of an information field in the upstream direction,  $m_u$  represents a number of information frames between positive acknowledgment frames in the upstream direction,  $p_u$  represents a probability of an information frame being accepted

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in the upstream direction,  $k_u$  represents a maximum number of transmissions in the upstream direction,  $A_u$  represents a number of information bits per unit time in the upstream direction,  $V_u$  represents a data rate in the upstream direction, and  $V_d$  represents a data rate in the downstream direction.

11. (Previously presented) A method of increasing a bit load of a multicarrier system comprising a channel having a plurality of subchannels, comprising:

determining a bit load for at least one subchannel based on a target symbol error rate  $\epsilon_s$ , a maximum number of symbol errors that can be corrected  $t$ , a number of symbols in an information field  $K$ , and a maximum number of transmissions  $k$ , and a number of bits per subchannel; and

selecting the maximum number of symbol errors  $t$ , the number of symbols in the information field  $K$  and the maximum number of transmissions  $k$ , such that a coding gain is increased.

12. (Previously presented) The method of claim 11 wherein the coding gain is a function of an average number of transmissions for a frame.

13. (Original) The method of claim 11 wherein the bit load is determined in accordance with the following relationships:

$$1 - \left( 1 - W(t, K, k) \epsilon_s^{\frac{1}{(t+1)k}} \right)^{1/\alpha} \\ = \omega(b_i) (1 - 2^{-b_i/2}) \operatorname{erfc} \left( \sqrt{3 \cdot 10^{\gamma/10} / (2^{b_i+1} - 2)} \right) \left[ 2 - (1 - 2^{-b_i/2}) \operatorname{erfc} \left( \sqrt{3 \cdot 10^{\gamma/10} / (2^{b_i+1} - 2)} \right) \right]$$

wherein  $b_i$  represents a number of bits per subchannel,  $\gamma$  represents a signal-to-noise ratio at the  $i$ -th subchannel,  $\omega(b_i)$  represents an average fraction of erroneous bits in a  $b_i$ -sized erroneous quadrature-amplitude-modulation symbol,  $\epsilon_s$  represents a target symbol error rate,  $\beta$  represents an effect of a descrambler, and  $\alpha$  represent a number of bits per code symbol; and

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$$W(t, K, k) = \left[ \binom{K+C+R-1}{t} \right]^{\frac{1}{(t+1)k}} \left[ \binom{K+C+R}{t+1} \right]^{\frac{k-1}{(t+1)k}}$$

$C+R$  represents a number of redundant symbols in an error correction field, and the net coding gain  $G_n(t, K, k)$  is determined in accordance with the following relationship:

$$G_n(t, K, k) = \frac{K}{K+C+R} \frac{B_{DMT}(t, K, k)}{\nu} - \frac{K}{K+C} B_{DMT}(0, K, 1)$$

$\nu$  represents an average number of transmissions, and  $B_{DMT}(t, K, k)$  represents a number of bits in a discrete multitone symbol based on the values of  $t$ ,  $K$  and  $k$ .

14. (Original) The method of claim 13 wherein  $\omega(b_i)$  is approximated in accordance with the following relationship:

$$\omega(b_i) = \frac{4}{3+2 \cdot b_i}$$

15. (Original) The method of claim 13 wherein  $\epsilon_s$  is determined in accordance with the following relationship:

$$\epsilon_s = 1 - \left( 1 - \frac{\epsilon}{\beta} \right)^\alpha,$$

and  $\epsilon$  represents a target bit error rate,  $\alpha$  represents a length of a code symbol, and  $\beta$  represents the effect of a descrambler.

16. (Original) The method of claim 13 wherein  $\omega(b_i)$  is determined in accordance with the following relationship:

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$$\omega(b) = \frac{1}{b \cdot 2^b} \sum_{i=1}^2 \sum_{j \neq i} \frac{d_H(a_i, a_j)}{\chi_i},$$

$b$  represents a number of bit positions of a quadrature-amplitude-modulation symbol,  $a_i$  represents a label for the  $i^{\text{th}}$  point of a constellation associated with a subchannel,  $a_j$  represents a label for the  $j^{\text{th}}$  point of a constellation associated with a subchannel, and  $\chi_i$  represents a coordination number of the  $a_i^{\text{th}}$  point,  $d_H(a_i, a_j)$  represents a Hamming distance between respective binary vectors associated with points  $a_i$  and  $a_j$ .

17. (Original) The method of claim 11 further comprising:  
determining a total increase in the number of bits to be sent in a DMT symbol ( $G_d(t, K, k)$ ) in accordance with the following relationship:

$$G_d(t, K, k) \equiv B_{DMT}(t, K, k) - B_{DMT}(0, K, 1).$$

18. (Previously presented) A method of determining an uncoded bit error rate  $p_b$  based on a target symbol error rate  $\epsilon_s$  and a maximum number of transmissions  $k$ , comprising:  
determining the uncoded bit error rate  $p_b$  based on a weighted series expansion of the target bit error rate  $\epsilon_s$ , comprising weights  $W$  that are a function of a maximum number of symbol errors that can be corrected  $t$  and a number of symbols in an information field  $K$ ; and

selecting the maximum number of symbol errors  $t$ , the number of symbols in the information field  $K$  and the maximum number of transmissions  $k$ , such that the uncoded bit error rate  $p_b$  that produces a symbol error rate that is less than or equal to the target symbol error rate  $\epsilon_s$  is largest.

19. (Original) The method of claim 18 wherein said weighted series expansion to determine said uncoded bit error rate  $p_b$  comprises the following relationship:

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$$p_b = 1 - \left( 1 - W(t, K, k) \varepsilon_s^{\frac{1}{(t+1)k}} \right)^{1/\alpha}$$

wherein

$$W(t, K, k) = \left[ \binom{K+C+R-1}{t} \right]^{\frac{1}{(t+1)k}} \left[ \binom{K+C+R}{t+1} \right]^{\frac{k-1}{(t+1)k}},$$

C+R represents a number of redundant symbols in an error correction field.

20. (Previously presented) A method of selecting transmission parameters a multicarrier system having a channel comprising a plurality of subchannels, comprising:

selecting a number (s) of discrete multi-tone symbols in a forward-error-correction frame, a number (z) of forward-error-correction control symbols in a discrete multitone symbol, and a maximum number of transmissions (k), based on a signal-to-noise ratio and a number of subchannels associated with the signal-to-noise ratio; and

transmitting information in accordance with the selected number (s) of discrete multi-tone symbols, the number (z) of forward-error-correction control symbols in the discrete multitone symbol and the maximum number of transmissions (k).

21. (Original) The method of claim 20 wherein said selecting comprises selecting an adjustment value per subchannel based on the signal-to-noise ratio and the number of subchannels associated with the signal-to-noise ratio; and

adjusting a number of bits per subchannel for at least one subchannel in accordance with the adjustment value.

22. (Original) The method of claim 20 wherein the signal-to-noise ratio is an average signal-to-noise ratio of the associated number of subchannels.

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23. (Previously presented) The method of claim 20 further comprising:  
 storing, in a table, the number (s) of discrete multi-tone symbols in the forward-error-correction frame, the number (z) of forward-error-correction control symbols in the discrete multitone symbol associated with the signal-to-noise ratio, the maximum number of transmissions (k) and the number of subchannels associated with the signal-to-noise ratio, for different values of s, z, signal-to-noise ratios and numbers of subchannels.

24. (Original) The method of claim 23 wherein for each value of signal-to-noise ratio and number of bits per subchannel of the table, the associated values of s, z and k are also associated with an adjustment value that provides a maximal net coding gain  $g_m$  such that the associated values of s, z and k is selected from a subset of associated s, z and k values.

25. (Original) A method of determining an optimum bit load b per subchannel in a multicarrier system with forward error correction, comprising:  
 computing one or more values of a maximum number of symbol errors that can be corrected t, a number of symbols in the information field K and a maximum number of transmissions k to determine the optimum bit load per subchannel in accordance with the following relationship:

$$b = [\gamma + \Phi(\gamma, t, K, k, \epsilon)] / 10 \log 2$$

wherein

$$\Phi(\gamma, t, K, k, \epsilon) = 10 \log \left[ 10^{-\gamma/10} + \frac{3 \log e}{2 \log \left[ \frac{\alpha \langle \omega(b) \rangle \sqrt{8/\pi}}{W(t, K, k) (\alpha \epsilon / \beta)^{1/(t+1)k}} \right] - \log \log \left[ \frac{\alpha \langle \omega(b) \rangle \sqrt{8/\pi}}{W(t, K, k) (\alpha \epsilon / \beta)^{1/(t+1)k}} \right] + \log \left( \frac{\log e}{2} \right)} \right]$$



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$$W(i, K, k) = \left[ \binom{K+C+R-1}{i} \right]^{\frac{1}{(i+1)k}} \left[ \binom{K+C+R}{i+1} \right]^{\frac{k-1}{(i+1)k}},$$

$$\langle \omega(b) \rangle = \frac{1}{b_{\max}} \int_1^{b_{\max}} \omega(b) (1 - 2^{-b/2}) db$$

$\alpha$  represents a number of bits per symbol,  $\gamma$  represents a signal-to-noise ratio,  $\epsilon$  represents a target symbol error rate,  $k$  represents a maximum number of transmissions,  $C+R$  represents a number of redundant symbols in an error correction field,  $b$  represents a number of bit positions of a quadrature-amplitude-modulation symbol,  $\langle b \rangle$  represents an average fraction of erroneous bits in an erroneous  $b$ -sized quadrature-amplitude-modulation symbol, and  $b_{\max}$  is a maximum number of bit positions of the quadrature-amplitude-modulation symbol per subchannel; and

selecting a bit load per subchannel in accordance with the maximum number of symbol errors that can be corrected  $t$ , a number of symbols in the information field  $K$  and the maximum number of transmissions  $k$ .

26-31. (Cancelled)

32. (Cancelled)

33. (Previously presented) The apparatus of claim 32 wherein the representation is generated in accordance with the following relationships:

$$\frac{M_d}{K_d} \left[ \frac{1}{m_d} + \frac{1-p_d}{p_d} \right] \left[ 1 - (1-p_d)^{k_d} \right] \Lambda_d + \frac{N_u}{K_u} \frac{1 - (1-p_u)^{k_u}}{p_u} \Lambda_u \leq V_u, \text{ and}$$

$$\frac{N_d}{K_d} \frac{1 - (1-p_d)^{k_d}}{p_d} \Lambda_d + \frac{M_u}{K_u} \left[ \frac{1}{m_u} + \frac{1-p_u}{p_u} \right] \left[ 1 - (1-p_u)^{k_u} \right] \Lambda_u \leq V_d,$$

wherein  $M_d$  represents a length of an acknowledgment frame in a downstream direction,  $K_d$

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represents the length of an information field in the downstream direction,  $m_d$  represents a number of information frames between positive acknowledgment frames in the downstream direction,  $p_d$  represents a probability of an information frame being accepted in the downstream direction,  $k_d$  represents a maximum number of transmissions in the downstream direction,  $\Lambda_d$  represents a number of information bits per unit time in the downstream direction,  $N_d$  represents a total frame length in the downstream direction,  $M_u$  represents a length of an acknowledgment frame in an upstream direction,  $N_u$  represents a total frame length in the upstream direction,  $K_u$  represents the length of an information field in the upstream direction,  $m_u$  represents a number of information frames between positive acknowledgment frames in the upstream direction,  $p_u$  represents a probability of an information frame being accepted in the upstream direction,  $k_u$  represents a maximum number of transmissions in the upstream direction,  $\Lambda_u$  represents a number of information bits per unit time in the upstream direction,  $V_u$  represents a data rate in the upstream direction, and  $V_d$  represents a data rate in the downstream direction.

34. (Original) An apparatus for determining throughput in a multicarrier transmission system, comprising:

means for determining the throughput of a channel in an upstream and downstream direction in accordance with the following relationships:

$$H_u = \max \Lambda_u = \min \left\{ \begin{array}{l} V_u / \left[ \frac{N_d}{K_d} \frac{1 - (1 - p_d)^{k_d}}{p_d} + \frac{M_u}{K_u} \frac{V_u}{V_d} \left( \frac{1}{m_u} + \frac{1 - p_u}{p_u} \right) (1 - (1 - p_u)^{k_u}) \right], \\ V_u / \left[ \frac{M_d}{K_d} \frac{V_d}{V_u} \left( \frac{1}{m_d} + \frac{1 - p_d}{p_d} \right) (1 - (1 - p_d)^{k_d}) + \frac{N_u}{K_u} \frac{1 - (1 - p_u)^{k_u}}{p_u} \right] \end{array} \right\}, \text{ and}$$

$$H_d = \max \Lambda_d = \min \left\{ \begin{array}{l} V_d / \left[ \frac{N_d}{K_d} \frac{1 - (1 - p_d)^{k_d}}{p_d} + \frac{M_u}{K_u} \frac{V_u}{V_d} \left( \frac{1}{m_u} + \frac{1 - p_u}{p_u} \right) (1 - (1 - p_u)^{k_u}) \right], \\ V_d / \left[ \frac{M_d}{K_d} \frac{V_d}{V_u} \left( \frac{1}{m_d} + \frac{1 - p_d}{p_d} \right) (1 - (1 - p_d)^{k_d}) + \frac{N_u}{K_u} \frac{1 - (1 - p_u)^{k_u}}{p_u} \right] \end{array} \right\},$$

wherein  $M_d$  represents a length of an acknowledgment frame in a downstream direction,  $K_d$

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represents the length of an information field in the downstream direction,  $m_d$  represents a number of information frames between positive acknowledgment frames in the downstream direction,  $p_d$  represents a probability of an information frame being accepted in the downstream direction,  $k_d$  represents a maximum number of transmissions in the downstream direction,  $\lambda_d$  represents a number of information bits per unit time in the downstream direction,  $N_d$  represents a total frame length in the downstream direction,  $M_u$  represents a length of an acknowledgment frame in an upstream direction,  $N_u$  represents a total frame length in the upstream direction,  $K_u$  represents the length of an information field in the upstream direction,  $m_u$  represents a number of information frames between positive acknowledgment frames in the upstream direction,  $p_u$  represents a probability of an information frame being accepted in the upstream direction,  $k_u$  represents a maximum number of transmissions in the upstream direction,  $\lambda_u$  represents a number of information bits per unit time in the upstream direction,  $V_u$  represents a data rate in the upstream direction, and  $V_d$  represents a data rate in the downstream direction.

35. (Previously presented) An apparatus for increasing a bit load of a multicarrier system comprising a channel having a plurality of subchannels, comprising:

means for determining a bit load for at least one subchannel based on a target symbol error rate  $\epsilon_s$ , a maximum number of symbol errors that can be corrected  $t$ , a number of symbols in an information field  $K$ , and a maximum number of transmissions  $k$ , and a number of bits per subchannel; and

means for selecting the maximum number of symbol errors  $t$ , the number of symbols in the information field  $K$  and the maximum number of transmissions  $k$ , such that a coding gain is increased.

36. (Original) The apparatus of claim 35 wherein the coding gain is a function of an average number of transmissions for a frame.

37. (Original) The apparatus of claim 35 wherein the bit load is determined in accordance with the following relationships:

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$$1 - \left( 1 - W(t, K, k) \epsilon_s^{\frac{1}{(t+1)k}} \right)^{1/\alpha}$$

$$= \omega(b_i) (1 - 2^{-b_i/2}) \operatorname{erfc} \left( \sqrt{3 \cdot 10^{7/10} / (2^{b_i+1} - 2)} \right) \left[ 2 - (1 - 2^{-b_i/2}) \operatorname{erfc} \left( \sqrt{3 \cdot 10^{7/10} / (2^{b_i+1} - 2)} \right) \right]$$

wherein  $b_i$  represents a number of bits per subchannel,  $\gamma_i$  represents a signal-to-noise ratio at the  $i$ -th subchannel,  $\omega(b_i)$  represents an average fraction of erroneous bits in a  $b_i$ -sized erroneous quadrature-amplitude-modulation symbol,  $\epsilon_s$  represents a target symbol error rate,  $\beta$  represents an effect of a descrambler, and  $\alpha$  represent a number of bits per code symbol; and

$$W(t, K, k) = \left[ \binom{K+C+R-1}{t} \right]^{\frac{1}{(t+1)k}} \left[ \binom{K+C+R}{t+1} \right]^{\frac{k-1}{(t+1)k}}$$

$C+R$  represents a number of redundant symbols in an error correction field, and the net coding gain  $G_n(t, K, k)$  is determined in accordance with the following relationship:

$$G_n(t, K, k) \equiv \frac{K}{K+C+R} \frac{B_{DMT}(t, K, k)}{\nu} - \frac{K}{K+C} B_{DMT}(0, K, 1)$$

$\nu$  represents an average number of transmissions, and  $B_{DMT}(t, K, k)$  represents a number of bits in a discrete multitone symbol based on the values of  $t$ ,  $K$  and  $k$ .

38. (Original) The apparatus of claim 37 wherein  $\omega(b_i)$  is approximated in accordance with the following relationship:

$$\omega(b_i) = \frac{4}{3 + 2^{-b_i}}$$

39. (Original) The apparatus of claim 37 wherein  $\epsilon_s$  is determined in accordance with the following relationship:

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$$\varepsilon_s = 1 - \left(1 - \frac{\varepsilon}{\beta}\right)^\alpha,$$

and  $\varepsilon$  represents a target bit error rate,  $\alpha$  represents a length of a code symbol, and  $\beta$  represents the effect of a descrambler.

40. (Original) The apparatus of claim 37 wherein  $\omega(b_i)$  is determined in accordance with the following relationship:

$$\omega(b) = \frac{1}{b \cdot 2^b} \sum_{i=1}^b \sum_{j=i}^b \frac{d_H(a_i, a_j)}{\chi_i},$$

$b$  represents a number of bit positions of a quadrature-amplitude-modulation symbol,  $a_i$  represents a label for the  $i^{\text{th}}$  point of a constellation associated with a subchannel,  $a_j$  represents a label for the  $j^{\text{th}}$  point of a constellation associated with a subchannel, and  $\chi_i$  represents a coordination number of the  $a_i^{\text{th}}$  point,  $d_H(a_i, a_j)$  represents a Hamming distance between respective binary vectors associated with points  $a_i$  and  $a_j$ .

41. (Original) The apparatus of claim 35 further comprising:

means for determining a total increase in the number of bits to be sent in a DMT symbol ( $G_d(t, K, k)$ ) in accordance with the following relationship:

$$G_d(t, K, k) \equiv B_{DMT}(t, K, k) - B_{DMT}(0, K, 1).$$

42. (Previously presented) An apparatus for determining an uncoded bit error rate  $p_b$  based on a target symbol error rate  $\varepsilon_s$  and a maximum number of transmissions  $k$ , comprising:

means for determining the uncoded bit error rate  $p_b$  based on a weighted series expansion of the target bit error rate  $\varepsilon_s$ , comprising weights  $W$  that are a function of a maximum number of symbol errors that can be corrected  $t$  and a number of symbols in an information field  $K$ ; and

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means for selecting the maximum number of symbol errors  $t$ , the number of symbols in the information field  $K$  and the maximum number of transmissions  $k$ , such that the uncoded bit error rate  $p_b$  that produces a symbol error rate that is less than or equal to the target symbol error rate  $\varepsilon_s$  is largest.

43. (Original) The apparatus of claim 42 wherein said weighted series expansion to determine said uncoded bit error rate  $p_b$  comprises the following relationship:

$$p_b = 1 - \left( 1 - W(t, K, k) \varepsilon_s^{\frac{1}{(t+1)k}} \right)^{1/\alpha}$$

wherein

$$W(t, K, k) = \left[ \binom{K+C+R-1}{t} \right]^{\frac{1}{(t+1)k}} \left[ \binom{K+C+R}{t+1} \right]^{\frac{k-1}{(t+1)k}},$$

$C+R$  represents a number of redundant symbols in an error correction field.

44. (Original) An apparatus for selecting transmission parameters a multicarrier system having a channel comprising a plurality of subchannels, comprising:

means for selecting a number ( $s$ ) of discrete multi-tone symbols in a forward-error-correction frame, a number ( $z$ ) of forward-error-correction control symbols in a discrete multitone symbol, and a maximum number of transmissions ( $k$ ), based on a signal-to-noise ratio and a number of subchannels associated with the signal-to-noise ratio; and

means for transmitting information in accordance with the selected number ( $s$ ) of discrete multi-tone symbols, the number ( $z$ ) of forward-error-correction control symbols in the discrete multitone symbol and the maximum number of transmissions ( $k$ ).

45. (Original) The apparatus of claim 44 wherein said means for selecting comprises selecting an adjustment value per subchannel based on the signal-to-noise ratio and the

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number of subchannels associated with the signal-to-noise ratio; and

means for adjusting a number of bits per subchannel for at least one subchannel in accordance with the adjustment value.

46. (Original) The apparatus of claim 44 wherein the signal-to-noise ratio is an average signal-to-noise ratio of the associated number of subchannels.

47. (Original) The apparatus of claim 44 further comprising:

means for storing, in a table, the number (s) of discrete multi-tone symbols in the forward-error-correction frame, the number (z) of forward-error-correction control symbols in the discrete multitone symbol associated with the signal-to-noise ratio, the maximum number of transmissions (k) and the number of subchannels associated with the signal-to-noise ratio, for different values of s, z, signal-to-noise ratios and numbers of subchannels.

48. (Original) The apparatus of claim 47 wherein for each value of signal-to-noise ratio and number of bits per subchannel of the table, the associated values of s, z and k are also associated with an adjustment value that provides a maximal net coding gain  $g_n$  such that the associated values of s, z and k is selected from a subset of associated s, z and k values.

49. (Original) An apparatus for determining an optimum bit load b per subchannel in a multicarrier system with forward error correction, comprising:

means for computing one or more values of a maximum number of symbol errors that can be corrected t, a number of symbols in the information field K and a maximum number of transmissions k to determine the optimum bit load per subchannel in accordance with the following relationship:

$$b = \lceil \gamma + \Phi(\gamma, t, K, k, \epsilon) \rceil / 10 \log 2$$

wherein

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$$\Phi(\gamma, t, K, k, \epsilon) = 10 \log \left\{ 10^{-\gamma/10} + \frac{3 \log e}{2 \log \left[ \frac{\alpha \langle \omega(b) \rangle \sqrt{8/\pi}}{W(t, K, k) (\alpha \epsilon / \beta)^{1/(i+1)^k}} \right] - \log \log \left[ \frac{\alpha \langle \omega(b) \rangle \sqrt{8/\pi}}{W(t, K, k) (\alpha \epsilon / \beta)^{1/(i+1)^k}} \right] + \log \left( \frac{\log e}{2} \right)} \right\}$$

$$W(t, K, k) = \left[ \binom{K+C+R-1}{t} \right]^{1/(i+1)^k} \left[ \binom{K+C+R}{t+1} \right]^{k-1/(i+1)^k}$$

$$\langle \omega(b) \rangle = \frac{1}{b_{\max}} \int_1^{b_{\max}} \omega(b) (1 - 2^{-b/2}) db$$

$\alpha$  represents a number of bits per symbol,  $\gamma$  represents a signal-to-noise ratio,  $\epsilon$  represents a target symbol error rate,  $k$  represents a maximum number of transmissions,  $C+R$  represents a number of redundant symbols in an error correction field,  $b$  represents a number of bit positions of a quadrature-amplitude-modulation symbol,  $\langle b \rangle$  represents an average fraction of erroneous bits in an erroneous  $b$ -sized quadrature-amplitude-modulation symbol, and  $b_{\max}$  is a maximum number of bit positions of the quadrature-amplitude-modulation symbol per subchannel; and means for selecting a bit load per subchannel in accordance with the maximum number of symbol errors that can be corrected  $t$ , a number of symbols in the information field  $K$  and the maximum number of transmissions  $k$ .

50-55. (Cancelled)